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PATENT ABSTRACTS OF JAPAN

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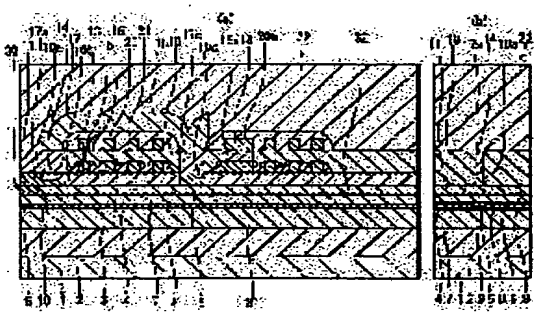
(54) THIN FILM MAGNETIC HEAD AND ITS MANUFACTURING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To precisely form the magnetic pole parts of an induction type electromagnetic transducing element and to prevent data from being written in areas other than those to be recorded.
SOLUTION: The recording head is equipped with a lower and upper magnetic pole layers 10, 17, a recording gap layer 14 provided b tween the magnetic pole parts of the magnetic layers 10, 17, and thin film coils 15, 20 at least a part of which is arranged between th magnetic pole layers 10, 17 and in a state insulated against the two magnetic pole layers 10, 17. The lower and upper magnetic pole layers 10, 17 are each provided with a magnetic pole part layer 10a, 17a and a yoke part layer 10b, 17b respectively. The end of each yoke part layer 10b, 17b on an air bearing face 30 side is situated at a position away from the air bearing face 30.



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CLAIMS

[Claim(s)]
[Claim 1] The medium opposed face which counters a record medium The 1st and 2nd magnetic layers which contain at least one layer including the magnetic pole portion which each other is connected magnetically and counters the aforementioned medium opposed face side mutually, respectively, The gap layer prepared between th magnetic pole portion of the 1st magnetic layer of the above, and the magnetic pole portion of the 2nd magnetic layer of the above, and the thin film coil with which the part [at least] was prepared in the state where it insulat d to the above 1st and the 2nd magnetic layer between the above 1st and the 2nd magnetic layer It is the thin film magnetic head equipped with the above. the 1st magnetic layer of the above The 1st magnetic pole partial layer which one field adjoins the aforementioned gap layer and contains the magnetic pole portion in the 1st magnetic layer, It connects with the field of another side of the magnetic pole partial layer of the above 1st, and has the 1st yoke partial layer used as the yoke portion in the 1st magnetic layer. the 2nd magnetic layer of the above The 2nd magnetic pole partial layer which one field adjoins the aforementioned gap layer and contains the magnetic pole portion in the 2nd magnetic layer, Connect with the field of another side of the magnetic pole partial layer of the above 2nd, and it has the 2nd yoke partial layer used as the yoke portion in the 2nd magnetic layer. The edge by th side of each medium opposed face of the yoke partial layer of the above 1st and the yoke partial layer of the abov 2nd is characterized by being arranged in the position distant from the medium opposed face, respectively.
[Claim 2] The magnetic pole partial layer of the above 1st and the magnetic pole partial layer of the above 2nd are the thin film magnetic head according to claim 1 to which an end is characterized by including the portion which has be n arranged at the medium opposed face, and which has width of face equal to the width of recording track, respectively.
[Claim 3] At least one side of the magnetic pole partial layer of the above 1st and the magnetic pole partial layer of the above 2nd is the thin film magnetic head according to claim 1 characterized by including the 2nd portion which a medium opposed face is arranged at an opposite side, and has larger width of face than the width of recording track rather than the 1st portion which an end is arranged at a medium opposed face and has width of face equal to the width of recording track, and the 1st portion of the above.
[Claim 4] Furthermore, the thin film magnetic head according to claim 1 to 3 characterized by having the insulating-lay r stowage which contains the insulating layer for a throat height convention for being formed in one side of th magnetic pole partial layer of the above 1st, and the magnetic pole partial layer of the above 2nd, and specifying throat height, and the insulating layer for a throat height convention contained by the aforementioned insulating-layer stowage.
[Claim 5] Some aforementioned thin film coils [at least] are the thin film magnetic head according to claim 1 to 4 characterized by being arranged in the side of the magnetic pole partial layer of the above 1st.
[Claim 6] Furthermore, the thin film magnetic head according to claim 5 characterized by having the coil insulation layer to which some thin film coils [at least] arranged in the side of the magnetic pole partial layer of the above 1st were covered, and flattening of the field by the side of the aforementioned gap layer was carried out with the field by the side of the gap layer in the magnetic pole partial layer of the above 1st.
[Claim 7] Some aforementioned thin film coils [at least] are the thin film magnetic head according to claim 1 to 4 characterized by being arranged in the side of the magnetic pole partial layer of the above 2nd.
[Claim 8] Furthermore, the thin film magnetic head according to claim 7 characterized by having the coil insulation lay r to which some thin film coils [at least] arranged in the side of the magnetic pole partial layer of the above 2nd were covered, and flattening of the field by the side of the yoke partial layer of the above 2nd was carried out with the field by the side of the 2nd yoke partial layer in the magnetic pole partial layer of the above 2nd.
[Claim 9] The medium opposed face which counters a record medium The 1st and 2nd magnetic layers which contain at least one layer including the magnetic pole portion which each other is connected magnetically and counters the aforementioned medium opposed face side mutually, respectively, The gap layer prepared between the magn tic pole portion of the 1st magnetic lay r of the above, and the magn tic pole portion of the 2nd magnetic layer of th above, and th thin film coil with which the part [at least] was pr pared in th state wh r it insulat d to the above 1st and the 2nd magn tic layer betw n th above 1st and th 2nd magnetic lay r The process which is th manufacture method of the thin film magnetic head equipped with the above, and forms th 1st magnetic layer of th above, At least th proc ss which forms th aforem ntioned gap lay r on the 1st magn tic layer of th abov , the process which forms the 2nd magnetic lay r of the above on the aforem ntioned gap layer, and a part between the abov 1st and th 2nd magnetic layer Th process which is equipped with the process which forms the

aforementioned thin film coil, and forms the 1st magnetic layer of the above so that it may be arranged in the state where it insulated to these the 1st and 2nd magnetic layers The 1st magnetic pole partial layer which one field adjoins the aforementioned gap layer and contains the magnetic pole portion in the 1st magnetic layer, Connect with the field of another side of the magnetic pole partial layer of the above 1st, and the 1st yoke partial layer used as the yoke portion in the 1st magnetic layer is formed. And the process which arranges the edge by the side of the medium opposed face of the yok partial layer of the above 1st in the position distant from the medium opposed face, and forms the 2nd magnetic layer of the above The 2nd magnetic pole partial layer which one field adjoins the aforementioned gap layer and contains the magnetic pole portion in the 2nd magnetic layer, It connects with the field of another side of the magnetic pole partial layer of the above 2nd, and the 2nd yoke partial layer used as the yok portion in the 2nd magnetic layer is formed, and it is characterized by arranging the edge by the side of the medium opposed face of the yoke partial layer of the above 2nd in the position distant from the medium opposed face.

[Claim 10] The magnetic pole partial layer of the above 1st and the magnetic pole partial layer of the above 2nd are the manufacture method of the thin film magnetic head according to claim 9 that an end is characterized by including the portion which has been arranged at the medium opposed face and which has width of face equal to the width of recording track, respectively.

[Claim 11] At least one side of the magnetic pole partial layer of the above 1st and the magnetic pole partial layer of th above 2nd is the manufacture method of the thin film magnetic head according to claim 9 characterized by including the 2nd portion which a medium opposed face is arranged at an opposite side, and has larger width of face than the width of recording track rather than the 1st portion which an end is arranged at a medium opposed face and has width of face equal to the width of recording track, and the 1st portion of the above.

[Claim 12] Furthermore, the manufacture method of the thin film magnetic head according to claim 9 to 11 characterized by having the process which forms the insulating-layer stowage which contains the insulating layer for a throat height convention for specifying throat height, and the process which forms the insulating layer for a throat height convention so that it may be contained by the aforementioned insulating-layer stowage to one side of the magnetic pole partial layer of the above 1st, and the magnetic pole partial layer of the above 2nd.

[Claim 13] The process which forms the aforementioned thin film coil is the manufacture method of the thin film magnetic head according to claim 9 to 12 characterized by arranging some aforementioned thin film coils [at least] to the side of the magnetic pole partial layer of the above 1st.

[Claim 14] Furthermore, the manufacture method of the thin film magnetic head according to claim 13 characterized by having the process which forms the coil insulation layer to which some thin film coils [at least] arranged in the side of the magnetic pole partial layer of the above 1st were covered, and flattening of the field by the side of the aforementioned gap layer was carried out with the field by the side of the gap layer in the magnetic pole partial lay r of th above 1st.

[Claim 15] The process which forms the aforementioned thin film coil is the manufacture method of the thin film magnetic head according to claim 9 to 12 characterized by arranging some aforementioned thin film coils [at least] to the side of the magnetic pole partial layer of the above 2nd.

[Claim 16] Furthermore, the manufacture method of the thin film magnetic head according to claim 15 characterized by having the process which forms the coil insulation layer to which some thin film coils [at least] arranged in the side of the magnetic pole partial layer of the above 2nd were covered, and flattening of the field by the side of the yok partial layer of the above 2nd was carried out with the field by the side of the 2nd yoke partial layer in the magnetic pole partial layer of the above 2nd.

[Claim 17] The medium opposed face which counters a record medium Magnetic resistance element The r producing head which has the 1st and 2nd shield layers which are arranged so that the part by the side of the afor mentioned medium opposed face may counter on both sides of the aforementioned magnetic resistance element, and shield the aforementioned magnetic resistance element The 1st and 2nd magnetic layers which contain at l ast one layer including the magnetic pole portion which each other is connected magnetically and counters the afor mentioned medium opposed face side mutually, respectively The gap layer prepared between the magnetic pol portion of the 1st magnetic layer of the above, and the magnetic pole portion of the 2nd magnetic layer of the abov , and the thin film coil with which the part [at least] was prepared in the state where it insulated to the abov 1st and the 2nd magnetic layer between the above 1st and the 2nd magnetic layer It is the thin film magnetic head equipped with the above. the 1st magnetic layer of the above The magnetic pole partial layer which one field adjoins the aforementioned gap layer and contains the magnetic pole portion in the 1st magnetic layer, It connects with the field of another side of the aforementioned magnetic pole partial layer, has a yoke partial layer used as the yoke portion in the 1st magnetic layer, and is characterized by arranging the edge by the side of the medium opposed face of the aforementioned yoke partial layer in the position distant from the medium opposed face.

[Claim 18] The aforementioned magnetic pole partial layer is the thin film magnetic head according to claim 17 charact rized by an end containing the portion which has been arranged at the m dium opposed face, and which has width of face equal to the width of recording track.

[Claim 19] The aforementioned magnetic pol partial lay r is the thin film magnetic h ad according to claim 17 charact riz d by including the 2nd portion which a medium oppos d face is arrang d at an opposite side, and has larger width of face than the width of recording track rath r than th 1st portion which an end is arranged at a medium opposed face and has width of face equal to th width of recording track, and th 1st portion of the abov .

[Claim 20] Furthermore, the thin film magnetic head according to claim 17 to 19 characterized by having the insulating-lay r stowag which contains the insulating layer for a throat h ight convention for being formed in the

aforementioned magnetic pole partial layer, and specifying throat height, and the insulating layer for a throat height convention contained by the aforementioned insulating-layer stowage.
[Claim 21] Some aforementioned thin film coils [at least] are the thin film magnetic head according to claim 17 to 20 charact rized by being arranged in the side of the aforementioned magnetic pole partial layer.
[Claim 22] Furthermore, the thin film magnetic head according to claim 21 characterized by having the coil insulation layer to which some thin film coils [at least] arranged in the side of the aforementioned magnetic pole partial layer wer covered, and flattening of the field by the side of the aforementioned gap layer was carried out with the field by the side of the gap layer in the aforementioned magnetic pole partial layer.
[Claim 23] The medium opposed face which counters a-record medium Magnetic resistance element The reproducing head which has the 1st and 2nd shield layers which are arranged so that the part by the side of the aforementioned medium opposed face may counter on both sides of the aforementioned magnetic resistance element, and shield the aforementioned magnetic resistance element The 1st and 2nd magnetic layers which contain at l ast one layer including the magnetic pole portion which each other is connected magnetically and counters th aforementioned medium opposed face side mutually, respectively The gap layer prepared between the magnetic pole portion of the 1st magnetic layer of the above, and the magnetic pole portion of the 2nd magnetic layer of the above, and the thin film coil with which the part [at least] was prepared in the state where it insulated to the above 1st and the 2nd magnetic layer between the above 1st and the 2nd magnetic layer The process which is th manufacture method of the thin film magnetic head equipped with the above, and forms the aforementioned reproducing head, At least the process which forms the 1st magnetic layer of the above, the process which forms th aforementioned gap layer on the 1st magnetic layer of the above, the process which forms the 2nd magnetic layer of the above on the aforementioned gap layer, and a part between the above 1st and the 2nd magnetic layer Th process which is equipped with the process which forms the aforementioned thin film coil, and forms the 1st magnetic layer of the above so that it may be arranged in the state where it insulated to these the 1st and 2nd magnetic layers The magnetic pole partial layer which one field adjoins the aforementioned gap layer and contains th magnetic pole portion in the 1st magnetic layer, It connects with the field of another side of the aforementioned magnetic pole partial layer, and the yoke partial layer used as the yoke portion in the 1st magnetic layer is formed, and it is characterized by arranging the edge by the side of the medium opposed face of the aforementioned yoke partial layer in the position distant from the medium opposed face.
[Claim 24] The aforementioned magnetic pole partial layer is the manufacture method of the thin film magnetic head according to claim 23 characterized by an end containing the portion which has been arranged at the medium opposed face, and which has width of face equal to the width of recording track.
[Claim 25] The aforementioned magnetic pole partial layer is the manufacture method of the thin film magnetic head according to claim 23 characterized by including the 2nd portion which a medium opposed face is arranged at an opposite side, and has larger width of face than the width of recording track rather than the 1st portion which an end is arranged at a medium opposed face and has width of face equal to the width of recording track, and the 1st portion of the above.
[Claim 26] Furthermore, the manufacture method of the thin film magnetic head according to claim 23 to 25 characterized by having the process which forms the insulating-layer stowage which contains the insulating layer for a throat height convention for specifying throat height, and the process which forms the insulating layer for a throat height convention so that it may be contained by the aforementioned insulating-layer stowage to the aforementioned magnetic pole partial layer.
[Claim 27] The process which forms the aforementioned thin film coil is the manufacture method of the thin film magnetic head according to claim 23 to 26 characterized by arranging some aforementioned thin film coils [at least] to the side of the aforementioned magnetic pole partial layer.
[Claim 28] Furthermore, the manufacture method of the thin film magnetic head according to claim 27 characterized by having the process which forms the coil insulation layer to which some thin film coils [at least] arranged in the side of the aforementioned magnetic pole partial layer were covered, and flattening of the field by the side of the afor mentioned gap layer was carried out with the field by the side of the gap layer in the aforementioned magnetic pole partial layer.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Th technical field to which invention belongs] this invention — at least — an induction type — electromagnetism — it is related with the thin film magnetic head which has a sensing element, and its manufacture method
[0002]
[D scription of the Prior Art] In recent years, the improvement in a performance of the thin film magnetic head is call d for with improvement in the field recording density of a hard disk drive unit. as the thin film magnetic head — the induction type for writing — electromagnetism — the compound-die thin film magnetic head of the structure which carried out the laminating of the reproducing head which reads with the recording head which has a sensing element, and has the magnetic-reluctance (it is hereafter described also as MR (Magneto-resistive).) element of business is used widely
[0003] By the way, in order to raise recording density among the performances of a recording head, it is necessary to raise the track density in a magnetic-recording medium. It is necessary to realize the recording head of the ** truck structure which narrowed width of face in the pneumatic bearing side of the lower magnetic pole formed in th upper and lower sides on both sides of the record gap layer, and an up magnetic pole from several microns to the submicron size, and for that, in order to attain this, semiconductor processing technology is used.
[0004] Here, with reference to drawing 26 or drawing 29 , an example of the manufacture method of the compound-die thin-film magnetic head is explained as an example of the manufacture method of the conventional thin film magnetic head. In addition, in drawing 26 or drawing 29 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.
[0005] By this manufacture method, first, as shown in drawing 26 , the insulating layer 102 which consists of an alumina (aluminum 2O3) is deposited by the thickness of about about 5-10 micrometers on the substrate 101 which consists of ARUTIKKU (aluminum 2O3, TiC). Next, the lower shield layer 103 for the reproducing heads which consists of a magnetic material is formed on an insulating layer 102.
[0006] Next, on the lower shield layer 103, the spatter deposition of the alumina is carried out at the thickness of 100-200nm, and the lower shield gap film 104 as an insulating layer is formed. Next, the MR element 105 for reproduction is formed on the lower shield gap film 104 at the thickness of dozens of nm. Next, the electrode layer 106 of the couple electrically connected to the MR element 105 is formed on the lower shield gap film 104.
[0007] Next, the up shield gap film 107 as an insulating layer is formed on the lower shield gap film 104 and the MR element 105, and the MR element 105 is laid underground in the shield gap film 104,107.
[0008] Next, on the up shield gap film 107, it consists of a magnetic material and the lower [an up shield layer-cum-] magnetic pole layer (it is hereafter described as a lower magnetic pole layer.) 108 used to the both sides of th reproducing head and a recording head is formed at the thickness of about 3 micrometers.
[0009] Next, as shown in drawing 27 , the record gap layer 109 which consists of an insulator layer, for example, an alumina film, is formed on the lower magnetic pole layer 108 at the thickness of 0.2 micrometers. Next, for magnetic-path formation, the record gap layer 109 is **********ed partially and contact hole 109a is formed. Next, the up magnetic pole chip 110 which consists of a magnetic material for recording heads is formed on the record gap layer 109 in a magnetic pole portion at the thickness of 0.5-1.0 micrometers. At this time, the magnetic layer 119 which consists of a magnetic material for magnetic-path formation on contact hole 109a for magnetic-path formation is formed simultaneously.
[0010] Next, as shown in drawing 28 , the record gap layer 109 and the lower magnetic pole layer 108 are **********ed by ion milling by using the up magnetic pole chip 110 as a mask. As shown in drawing 28 (b), the structure where some each side attachment walls of an up magnetic pole portion (up magnetic pole chip 110), th record gap layer 109, and the lower magnetic pole layer 108 were perpendicularly formed in the self-adjustment target is called trim (Trim) structure.
[0011] N xt, th insulating layer 111 which consists of an alumina film is form d in the whol surface at th thickness of about 3 micrometers. Next, it grinds and flatt ning of this insulating lay r 111 is carri d out until it reaches the front face of the up magnetic pol chip 110 and a magnetic layer 119.
[0012] N xt, th thin film coil 112 of th 1st layer for th recording heads of an induction typ which consists of copp r (Cu) is formed on th insulating layer 111 by which flatt ning was carried out. Next, a photoresist layer 113 is formed on an insulating lay r 111 and a coil 112 at a pred termined pattern. Next, in ord r to mak th front fac of a photoresist layer 113 flat, it heat-treats at pr determin d temperatur . Next, th thin film coil 114 of the 2nd

layer is formed on a photoresist layer 113. Next, a photoresist layer 115 is formed on a photoresist layer 113 and a coil 114 at a predetermined pattern. Next, in order to make the front face of a photoresist layer 115 flat, it heat-treats at predetermined temperature.

[0013] Next, as shown in drawing 29 , the up magnetic pole layer 116 which consists of a magnetic material for recording heads, for example, a permalloy, is formed on the up magnetic pole chip 110, a photoresist layer 113,115, and a magnetic layer 119. Next, the overcoat layer 117 which consists of an alumina is formed on the up magnetic pole layer 116. Finally the slider containing above-mentioned each class is machined, the pneumatic bearing side 118 of the thin film magnetic head containing a recording head and the reproducing head is formed, and the thin film magnetic head is completed.

[0014] Drawing 30 is the plan of the thin film magnetic head shown in drawing 29 . In addition, in this drawing, the overcoat layer 117, other insulating layers, and the insulator layer are omitted.

[0015] In drawing 29 (a), TH expresses throat height and MR-H expresses MR height. In addition, throat height means the length (height) from the edge by the side of a pneumatic bearing side of the portion which two magnetic pole layers counter through a record gap layer to the edge of an opposite side. Moreover, MR height means the length (height) from the edge by the side of the pneumatic bearing side of MR element to the edge of an opposite side. Moreover, in drawing 29 (b), P2W express magnetic pole width of face, i.e., recording track width of face. Ther is an apex angle (Apex Angle) as shown by theta else [, such as throat height and MR height,] in drawing 29 (a) as a factor which determines the performance of the thin film magnetic head. This apex angle says the angle of the straight line which connects the corner of the side by the side of the magnetic pole in the coil portion (henceforth the apex section) which was covered by the photoresist layer 113,115 and rose in the shape of a mountain, and th upper surface of an insulating layer 111 to make.

[0016]

[Problem(s) to be Solved by the Invention] In order to raise the performance of the thin film magnetic head, it is important to form correctly the throat height TH as shown in drawing 29 , MR height MR-H, the apex angle theta, and recording track width-of-face P2W.

[0017] In order to enable high surface density record especially in recent years (i.e., in order to form the recording head of ** truck structure), the submicron size of 1.0 micrometers or less is demanded of width-of-recording-track P2W. Therefore, the technology of processing an up magnetic pole into a submicron size using semiconductor processing technology is needed.

[0018] Here, it poses a problem that it is difficult to form minutely the up magnetic pole layer formed on the apex section.

[0019] By the way, as a method of forming an up magnetic pole layer, as shown in JP,7-262519,A, the frame galvanizing method is used, for example. When forming an up magnetic pole layer using the frame galvanizing method, on the whole, the thin electrode layer which consists of a permalloy is first formed by sputtering on the apex section. Next, on it, a photoresist is applied, patterning is carried out according to a photolithography process, and the frame for plating (outer frame) is formed. And an up magnetic pole layer is formed by the galvanizing method by using as a seed layer the electrode layer formed previously.

[0020] However, there is the difference of elevation 7-10 micrometers or more in the apex section and other portions, for example. On this apex section, a photoresist is applied by the thickness of 3-4 micrometers. Supposing the thickness of the photoresist on the apex section is at least 3-micrometer or more need, since the photoresist with a fluidity gathers for the method of a low, in the lower part of the apex section, a photoresist film with a thickness of 8-10 micrometers or more will be formed, for example.

[0021] In order to realize recording track width of face of a submicron size as mentioned above, it is necessary to form the frame pattern of the width of face of a submicron size with a photoresist film. Therefore, you have to form a pattern with a detailed submicron size on the apex section with a photoresist film with the thickness of 8-10 micrometers or more. However, it was very difficult on the manufacturing process to form the photoresist pattern of such thick thickness by ** pattern width of face.

[0022] And at the time of exposure of a photolithography, the light for exposure reflects by the ground electrode layer as a seed layer, a photoresist exposes, collapse of a photoresist pattern etc. arises and a sharp and exact photoresist pattern is no longer obtained by this reflected light.

[0023] Thus, when magnetic pole width of face became a submicron size conventionally, there was a trouble that it became difficult to form an up magnetic layer with a sufficient precision.

[0024] As drawing 27 of the above-mentioned conventional example or the process of drawing 29 also showed, after forming the width of recording track 1.0 micrometers or less from such a thing with the up magnetic pole chip 110 effective in formation of the ** truck of a recording head, the method of forming the up magnetic pole layer 116 used as the yoke portion connected with this up magnetic pole chip 110 is also adopted (refer to JP,62-245509,A and JP,60-10409,A). Thus, it becomes possible by dividing the usual up magnetic pole layer into the up magnetic pole layer 116 used as the up magnetic pole chip 110 and a yoke portion to form som what minut ly the up magnetic pol chip 110 which determines recording track width of fac on th flat fi ld n th r cord gap layer 109.

[0025] Moreover, the thin film magnetic head which constituted th magnetic pol portion from two layers of th layer used as th included lay r and a yoke portion is indicat d by JP,6-314413,A in the both sid s of an up magnetic pole layer and a low r magnetic pol layer.

[0026] However, also in the thin film magnetic head shown in drawing 29 , the apical surfac of th layer us d as a yoke portion is xpos d to a pneumatic bearing sid also in the thin film magnetic head indicated by JP,6-314413,A.

Therefore, in such the thin film magnetic head, not only the layer containing a magnetic pole portion but the layer side used as a yoke portion had the trouble which writing is performed and writes data also in fields other than the field which should originally be recorded to a record medium that the so-called side light was generated.
[0027] Moreover, in the thin film magnetic head indicated by JP,6-314413,A, the width of face of a total of four layers of two lay rs, two layers of an up magnetic pole layer and lower magnetic pole layers, is equally formed in the magnetic pole portion. Thus, as a method of forming four layers so that width of face may become equal in a magnetic pole portion, how to form each class so that the configuration of the magnetic pole portion of each class may be decided at the time of formation of each class, and the method of bundling up four layers and **********ing so that the width of face of four layers in a magnetic pole portion may become equal after forming four layers can be considered.
[0028] However, there is a trouble that it is difficult to determine the configuration of the magnetic pole portion of each class with a sufficient precision, and to perform alignment of the magnetic pole portion of each class with a sufficient precision when recording track width of face is made small especially by the method of forming each class so that the configuration of the magnetic pole portion of each class may be decided at the time of formation of each class.
[0029] Moreover, by the method of bundling up four layers and **********ing, while etching takes much time, ther is a trouble that it is difficult to determine the configuration of the magnetic pole portion of four layers with a sufficient precision.
[0030] Moreover, in the conventional thin film magnetic head, there was a trouble that it was difficult to shorten magnetic-path length (Yoke Length). That is, although the recording head which could realize the short head of magnetic-path length and was excellent in especially the RF property could be formed so that the coil pitch was small, when a coil pitch was made small infinite, the distance from a throat height zero position (position of the edge by the side of the pneumatic bearing side of the insulating layer which determines throat height) to the periphery edge of a coil had become the big factor which bars shortening magnetic-path length. Since magnetic-path length can do the two-layer coil short rather than the coil of one layer, he has adopted the two-layer coil in the recording head for many RFs. However, by the conventional magnetic head, after forming the coil of the 1st layer, in order to form the insulator layer between coils, the photoresist film is formed by the thickness of about 2 micrometers. Therefore, the small apex roundish [wore] is formed in the periphery edge of the coil of the 1st layer. Next, although the coil of a two-layer eye is formed on it, since etching of the seed layer of a coil cannot be performed but a coil short-circuits by the ramp of the apex section in that case, it is necessary to form the coil of a two-lay r eye in a flat part.
[0031] When follow, for example, thickness of a coil is set to 2-3 micrometers, thickness of the insulator layer between coils is set to 2 micrometers and an apex angle is made into 45 degrees - 55 degrees, as magnetic-path length Double precision of the 3-4-micrometer distance which is the distance of a up to [from the periphery edg of a coil] near the throat height zero position in addition to the length of the portion corresponding to a coil (3-4 micrometers also of distance from the contact section of an up magnetic pole layer and a lower magnetic pole layer to a coil inner circumference edge are also required.) 6-8 micrometers is required. Length other than the portion corresponding to this coil had become the factor which bars reduction of magnetic-path length.
[0032] Here, the case where the 11-volume coil whose space the line breadth of a coil is 1.2 micrometers and is 0.8 micrometers is formed by two-layer is considered. In this case, as shown in drawing 29 , when it is made the 1st layer into six volumes and a two-layer eye is made into five volumes, the length of the portion corresponding to th coil 112 of the 1st layer is 11.2 micrometers among magnetic-path length. A length of a total of six -8 micrometers is needed for magnetic-path length as a distance to the edge of the photoresist layer 113 for insulating the coil 112 of the 1st layer from the periphery edge and inner circumference edge of a coil 112 of the 1st layer. Therefore, magnetic-path length is set to 17.2-19.2 micrometers. Moreover, if a 11-volume coil is formed by one layer, magnetic-path length is set to 27.2-29.2 micrometers. In addition, as the sign L0 showed magnetic-path length in drawing 29 , the length of the portion except the magnetic pole portion of the magnetic pole layers and the contact portion expresses with this application. Thus, conventionally, reduction of magnetic-path length is difficult and this had barred the improvement of a RF property.
[0033] that by which this invention was made in view of this trouble — it is — the 1st purpose — an induction type — lectromagnetism — while being able to form the magnetic pole portion of a sensing element with a sufficient precision, it is in offering the thin film magnetic head which enabled it to prevent the writing of the data to fields oth r than the field which should be recorded, and its manufacture method
[0034] The 2nd purpose of this invention is to offer the thin film magnetic head which enabled reduction of magnetic-path length, and its manufacture method in addition to the 1st purpose of the above.
[0035]
[Means for Solving the Problem] The medium opposed face to which the 1st thin film magnetic head of this invention count rs a record medium, Th 1st and 2nd magnetic layers which c ntain at l ast on lay r including th magnetic pole portion which each oth r is conn ct d magnetically and counters a medium opposed fac sid mutually, resp ctively, At least the gap lay r pr par d between th magn tic pole portion of the 1st magnetic lay r and the magn tic pol portion of the 2nd magn tic lay r and a part b tween th 1st and 2nd magnetic layers It is the thin film magnetic h ad quipped with the thin film coil prepared in th stat where it insulated to th 1st and 2nd magn tic layers. the 1st magnetic layer Th 1st magnetic pol partial layer which one fi ld adjoins a gap layer and contains th magnetic pole portion in th 1st magnetic layer, It conn cts with th field of another sid of the

1st magn tic pole partial layer, and has the 1st yoke partial layer used as the yoke portion in the 1st magnetic layer. the 2nd magnetic layer The 2nd magnetic pole partial layer which one field adjoins a gap layer and contains the magnetic pole portion in the 2nd magnetic layer, It connects with the field of another side of the 2nd magnetic pole partial layer, and has the 2nd yoke partial layer used as the yoke portion in the 2nd magnetic layer, and the edge by the sid of each medium opposed face of the 1st yoke partial layer and the 2nd yoke partial layer is arranged in th position distant from th medium opposed face, respectively.

[0036] The manufacture method of the 1st thin film magnetic head of this invention The medium opposed face which counters a record medium, and the 1st and 2nd magnetic layers which contain at least one layer including the magnetic pole portion which each other is connected magnetically and counters a medium opposed face side mutually, respectively, At least the gap layer prepared between the magnetic pole portion of the 1st magnetic layer and the magnetic pole portion of the 2nd magnetic layer and a part between the 1st and 2nd magnetic layers The process which is the method of manufacturing the thin film magnetic head equipped with the thin film coil prepared in the state where it insulated to the 1st and 2nd magnetic layers, and forms the 1st magnetic layer, At least the process which forms a gap layer on the 1st magnetic layer, the process which forms the 2nd magnetic layer on a gap layer, and a part between the 1st and 2nd magnetic layers The process which is equipped with the process which forms a thin film coil, and forms the 1st magnetic layer so that it may be arranged in the state where it insulated to these the 1st and 2nd magnetic layers The 1st magnetic pole partial layer which one field adjoins a gap layer and contains the magnetic pole portion in the 1st magnetic layer, Connect with the field of another side of th 1st magnetic pole partial layer, and the 1st yoke partial layer used as the yoke portion in the 1st magnetic layer is formed. And the process which arranges the edge by the side of the medium opposed face of the 1st yoke partial layer in the position distant from the medium opposed face, and forms the 2nd magnetic layer The 2nd magnetic pol partial layer which one field adjoins a gap layer and contains the magnetic pole portion in the 2nd magnetic layer, It connects with the field of another side of the 2nd magnetic pole partial layer, and the 2nd yoke partial layer used as the yoke portion in the 2nd magnetic layer is formed, and the edge by the side of the medium opposed face of the 2nd yoke partial layer is arranged in the position distant from the medium opposed face.

[0037] By the 1st thin film magnetic head or its manufacture method of this invention both, since it is arranged in the position where the 1st magnetic layer and 2nd magnetic layer have a magnetic pole partial layer and a yoke partial layer, and the edge by the side of the medium opposed face of each yoke partial layer separated from the medium opposed face, it is possible to form two magnetic pole partial layers with a sufficient precision, and, thereby, it becomes possible to form a magnetic pole portion with a sufficient precision. Moreover, in this invention, since th edge by the side of the medium opposed face of each yoke partial layer is arranged in the position distant from the medium opposed face, the writing of the data to fields other than the field which should be recorded is prevented.

[0038] In the 1st thin film magnetic head or its manufacture method of this invention, the 1st magnetic pole partial layer and the 2nd magnetic pole partial layer may contain the portion which has the width of face equal to the width of recording track by which the end has been arranged at the medium opposed face, respectively.

[0039] Moreover, in the 1st thin film magnetic head or its manufacture method of this invention, the 2nd portion into which a medium opposed face is arranged at an opposite side, and has larger width of face than the width of recording track may be included rather than the 1st portion into which an end is arranged at a medium opposed face and at least one side of the 1st magnetic pole partial layer and the 2nd magnetic pole partial layer has width of face equal to the width of recording track, and the 1st portion.

[0040] Moreover, in the 1st thin film magnetic head or its manufacture method of this invention, it is formed in one side of the 1st magnetic pole partial layer and the 2nd magnetic pole partial layer, and the insulating-layer stowage which contains the insulating layer for a throat height convention for specifying throat height, and the insulating lay r for a throat height convention contained by the insulating-layer stowage may be prepared.

[0041] Moreover, in the 1st thin film magnetic head or its manufacture method of this invention, some thin-film coils [at least] may be arranged in the side of the 1st magnetic pole partial layer. In this case, some thin film coils [at least] arranged in the side of the 1st magnetic pole partial layer may be covered, and the coil insulation layer to which flattening of the field by the side of a gap layer was carried out with the field by the side of the gap layer in the 1st magnetic pole partial layer may be prepared.

[0042] Moreover, in the 1st thin film magnetic head or its manufacture method of this invention, some thin film coils [at l ast] may be arranged in the side of the 2nd magnetic pole partial layer. In this case, some thin film coils [at least] arranged in the side of the 2nd magnetic pole partial layer may be covered, and the coil insulation layer to which flattening of the field by the side of the 2nd yoke partial layer was carried out with the field by the side of the 2nd yoke partial layer in the 2nd magnetic pole partial layer may be prepared.

[0043] The medium opposed face to which the 2nd thin film magnetic head of this invention counters a record medium, The reproducing head which has the 1st and 2nd shield layers which are arranged so that a magnetic resistance element and the part by the side of a medium opposed face may counter on both sides of a magnetic resistance lem nt, and shi ld a magnetic resistanc el m nt, Th 1st and 2nd magnetic layers which contain at l ast on layer including th magnetic pole portion which ach oth r is connect d magnetically and count rs a medium opposed face sid mutually, r spectively, At least th gap layer pr par d betw en th magnetic pole portion of th 1st magn tic layer and th magn tic pole portion of th 2nd magn tic layer and a part betw en the 1st and 2nd magn tic layers It has the r cording h ad which has th thin film coil pr par d in th state wher it insulated to th 1st and 2nd magn tic layers. The 1st magnetic layer is th thin film magnetic head arranged at the reproducing-head sid among the 1st and 2nd magn tic layers. the 1st magn tic layer Th magnetic pol partial layer which one

field adjoins a gap layer and contains the magnetic pole portion in the 1st magnetic layer, It connects with the field of another side of a magnetic pole partial layer, and has a yoke partial layer used as the yoke portion in the 1st magnetic layer, and the edge by the side of the medium opposed face of a yoke partial lay r is arranged in th position distant from th medium opposed face.

[0044] The manufacture method of the 2nd thin film magnetic head of this invention is a method of manufacturing the thin film magnetic head equipped with the medium opposed face and the reproducing head which count r a record medium, and the recording head. In the thin film magnetic head, the reproducing head is arranged so that a magnetic resistance element and the part by the side of a medium opposed face may counter on both sides of a magnetic resistance element, and it has the 1st and 2nd shield layers which shield a magnetic resistance element. The 1st and 2nd magnetic layers which contain at least one layer including the magnetic pole portion which the recording head of each other is connected magnetically and counters a medium opposed face side mutually, respectively, It has the gap layer prepared between the magnetic pole portion of the 1st magnetic layer, and the magnetic pole portion of the 2nd magnetic layer, and the thin film coil with which the part [at least] was prepared in the state where it insulated to the 1st and 2nd magnetic layers between the 1st and 2nd magnetic layers. Moreover, in the thin film magnetic head, the 1st magnetic layer is arranged among the 1st and 2nd magnetic layers at the reproducing-head side.

[0045] The manufacture method of the 2nd thin film magnetic head of this invention At least the process which forms the reproducing head, the process which forms the 1st magnetic layer, the process which forms a gap layer on the 1st magnetic layer, the process which forms the 2nd magnetic layer on a gap layer, and a part between th 1st and 2nd magnetic layers The process which is equipped with the process which forms a thin film coil, and forms the 1st magnetic layer so that it may be arranged in the state where it insulated to these the 1st and 2nd magnetic layers The magnetic pole partial layer which one field adjoins a gap layer and contains the magnetic pole portion in the 1st magnetic layer, It connects with the field of another side of a magnetic pole partial layer, and the yoke partial layer used as the yoke portion in the 1st magnetic layer is formed, and the edge by the side of the medium opposed face of a yoke partial layer is arranged in the position distant from the medium opposed face.

[0046] By the 2nd thin film magnetic head or its manufacture method of this invention, since it is arranged in the position where the 1st magnetic layer has a magnetic pole partial layer and a yoke partial layer, and the edge by th sid of the medium opposed face of a yoke partial layer separated from the medium opposed face, it is possible to form the magnetic pole partial layer of the 1st magnetic layer with a sufficient precision, and, thereby, it becomes possible to form a magnetic pole portion with a sufficient precision. Moreover, in this invention, since the edge by the side of the medium opposed face of a yoke partial layer is arranged in the position distant from the medium opposed face, the writing of the data to fields other than the field which should be recorded is prevented.

[0047] In the 2nd thin film magnetic head or its manufacture method of this invention, the magnetic pole partial layer may contain the portion which has the width of face equal to the width of recording track by which the end has been arranged at the medium opposed face.

[0048] Moreover, in the 2nd thin film magnetic head or its manufacture method of this invention, the 2nd portion into which a medium opposed face is arranged at an opposite side, and has larger width of face than the width of recording track may be included rather than the 1st portion into which an end is arranged at a medium opposed fac and a magnetic pole partial layer has width of face equal to the width of recording track, and the 1st portion.

[0049] Moreover, in the 2nd thin film magnetic head or its manufacture method of this invention, it is formed in a magnetic pole partial layer, and the insulating-layer stowage which contains the insulating layer for a throat height convention for specifying throat height, and the insulating layer for a throat height convention contained by the insulating-layer stowage may be prepared.

[0050] Moreover, in the 2nd thin film magnetic head or its manufacture method of this invention, some thin film coils [at least] may be arranged in the side of a magnetic pole partial layer. In this case, some thin film coils [at least] arranged in the side of a magnetic pole partial layer may be covered, and the coil insulation layer to which flattening of the field by the side of a gap layer was carried out with the field by the side of the gap layer in a magnetic pole partial layer may be prepared.

[0051]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained in detail with r f rence to a drawing.

[the gestalt of the 1st operation] — with reference to drawing 1 or drawing 9 , the thin film magnetic head concerning the gestalt of operation of the 1st of this invention and its manufacture method are explained first In addition, in drawing 1 or drawing 8 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.

[0052] By the manufacture method of the thin film magnetic head concerning the gestalt of this operation, first, as shown in drawing 1 , the insulating layer 2 which consists of an alumina (aluminum 2O3) is deposited by the thickness of about 5 micrometers on th substrate 1 which consists of ARUTIKKU (aluminum 2O3, TiC). N xt, th low r shi ld layer 3 for th reproducing h ads which consists of a magn tic material, for xample, a permall y, is formed on an insulating layer 2 at the thickn ss of about 3 micrometers. The lower shield layer 3 us s for exampl , a photoresist film as a mask, and forms it alternativ ly on an insulating layer 2 by the galvanizing m thod. Next, it grinds until it forms in the thickness of 4-5 microm t rs th insulating layer 31 which consists of an alumina, for example, the lower shield layer 3 is exposed to th whole with chemical machinery polish (it is hereafter described as CMP.), and flattening processing of th front fac is carried out.

[0053] Next, the lower shield gap film 4 as an insulator layer is formed on the lower shield layer 3 at the thickness of about 20-40nm. Next, the MR element 5 for reproduction is formed on the lower shield gap film 4 at the thickness of dozens of nm. The MR element 5 forms MR film formed by the spatter by **********ing alternatively. In addition, the element using the magnetosensitive film in which the magnetoresistance eff cts, such as the AMR element, a GMR element, or a TMR (tunnel magnetoresistance effect) element, are shown can be used for the MR element 5. Next, the electrode layer 6 of the coupl electrically connected to the MR el ment 5 is formed on the lower shield gap film 4 at the thickness of dozens of nm. Next, the up shield gap film 7 as an insulator layer is formed on the lower shield gap film 4 and the MR element 5 at the thickness of about 20-40nm, and the MR element 5 is laid underground in the shield gap film 4 and 7. As an insulating material used for the shield gap films 4 and 7, there are an alumina, alumimium nitride, diamond-like carbon (DLC), etc. Moreover, the shield gap films 4 and 7 may be formed by the spatter, and may be formed by the chemical vapor-growth (CVD) method. In forming the shield gap films 4 and 7 which consist of an alumina film by CVD, as a material, it uses a trimethylaluminum (aluminum3 (CH3)) and H2O. If CVD is used, it will become it is thin, and is precise and possible to form the few shield gap films 4 and 7 of a pinhole.

[0054] Next, the up shield layer 8 for the reproducing heads which consists of a magnetic material, for example, a permalloy, is formed on the up shield gap film 7 at the thickness of 1.0 micrometers.

[0055] Next, the insulator layer 9 which consists of an alumina in order to insulate the reproducing head and a recording head magnetically is formed on the up shield layer 8 at the thickness of 0.1-0.2 micrometers.

[0056] Next, as shown in drawing 2 , yoke partial layer 10b which becomes a yoke portion in the lower magnetic pole lay r 10 for recording heads by the magnetic material is alternatively formed by the thickness of 1.5 micrometers on an insulator layer 9. In addition, the lower magnetic pole layer 10 consists of this yoke partial layer 10b, and magnetic pole partial layer 10a and connection slice 10c which are mentioned later. The edge by the side of the pneumatic bearing side 30 of yoke partial layer 10b is arranged in the position distant from the pneumatic bearing side 30.

[0057] Using NiFe (nickel:80 % of the weight, Fe:20 % of the weight), NiFe (nickel:45 % of the weight, Fe:55 % of the weight) which is high saturation-magnetic-flux-density material, yoke partial layer 10b may be formed by the galvanizing method, and may be formed by the spatter using material, such as FeN, FeZrN, etc. which are high saturation-magnetic-flux-density material. In addition, you may use CoFe, Co system amorphous material, etc. which are high saturation-magnetic-flux-density material.

[0058] Next, it grinds until it forms in the thickness of about 2-3 micrometers the insulating layer which consists of an alumina, for example, yoke partial layer 10b is exposed to the whole with CMP, and flattening processing of the front face is carried out. Thereby, as shown in drawing 2 , in the portion from the edge by the side of the pneumatic bearing side 30 of yoke partial layer 10b to the pneumatic bearing side 30, an insulating layer 11 is formed on an insulator layer 9. Moreover, an insulating layer 32 is formed in other portions on an insulator layer 9.

[0059] Next, as shown in drawing 3 , while forming magnetic pole partial layer 10a of the lower magnetic pole layer 10 on an insulating layer 11 and yoke partial layer 10b, connection slice 10c is formed on yoke partial layer 10b. Magnetic pole partial layer 10a contains the magnetic pole portion in the lower magnetic pole layer 10. Connection slic 10c is arranged in the position near the center of the thin film coil mentioned later. Thickness of magnetic pole partial layer 10a and connection slice 10c is set to 1.0 micrometers.

[0060] Using NiFe (nickel:80 % of the weight, Fe:20 % of the weight), NiFe (nickel:45 % of the weight, Fe:55 % of the weight) which is high saturation-magnetic-flux-density material, magnetic pole partial layer 10a of the lower magnetic pole layer 10 and connection slice 10c may be formed by the galvanizing method, and may be formed by the spatter using material, such as FeN, FeZrN, etc. which are high saturation-magnetic-flux-density material. In addition, you may use CoFe, Co system amorphous material, etc. which are high saturation-magnetic-flux-density material.

[0061] Next, only 0.3-0.6 micrometers **********s the portion of an opposite side by ion milling etc. in the pneumatic bearing side 30 from a desired throat height zero position among the upper surfaces of magnetic pole partial layer 10a. The insulating-layer stowage 12 which contains by this the insulating layer for a throat height convention for specifying the throat height later mentioned into the portion of an opposite side in a throat height zero position to the pneumatic bearing side 30 in magnetic pole partial layer 10a is formed.

[0062] Next, it grinds until it forms in the thickness of about 2-3 micrometers the insulating layer 13 which consists of an alumina, for example, magnetic pole partial layer 10a and connection slice 10c are exposed to the whole with CMP, and flattening processing of the front face is carried out. As shown in drawing 3 , the portion contained by the insulating-layer stowage 12 among insulating layers 13 serves as an insulating layer for a throat height convention.

[0063] Next, as shown in drawing 4 , the record gap layer 14 which becomes the whole from an insulating material is formed in the thickness of 0.1-0.15 micrometers. Generally as an insulating material used for the record gap layer 14, there are an alumina, alumimium nitride, silicon oxide system material, silicon nitride system material, diamond-like carbon (DLC), tc. Moreover, the record gap layer 14 may be f rmed by th spatt r, and may be formed by the chemical vapor-growth (CVD) m thod. In forming the record gap lay r 14 which consists of an alumina film by CVD, as a material, it us s a trimethylaluminum (aluminum3 (CH3)) and H2O. If CVD is us d, it will becom it is thin, and is precise and possibl to form the few record gap layer 14 of a pinhol .

[0064] Next, for magn tic-path f rmation, in th position n ar th c nt r of the thin film coil mention d later, the record gap lay r 14 is **********ed partially and contact hole 14A is form d.

[0065] Next, the 1st layer portion 15 of th thin film coil which consists of copp r is form d by th frame galvanizing

method on the record gap layer 14 by the thickness of 1.0-2.0 micrometers, and the 1.2-2.0-micrometer coil pitch. The 1st layer portion 15 of a thin film coil is formed so that it may be wound focusing on connection slic 10c. In addition, sign 15a shows among drawing the connection for connecting with the 2nd layer portion 20 which m ntions the 1st layer portion 15 of a thin film coil later. Next, a photoresist layer 16 is formed so that the 1st lay r portion 15 of a thin film coil may be enclosed.

[0066] Next, as shown in drawing 5 , in the position near [by the side of the pneumatic bearing sid 30 of the record gap layer 14] the edge, magnetic pole partial layer 17a containing the magnetic pole portion in the up magnetic pole layer 17 is formed on the record gap layer 14. At this time, simultaneously, connection slice 17c is formed on contact hole 14A, and the connection layer 18 is formed on connection 15a in the 1st layer portion 15 of a thin film coil. Magnetic pole partial layer 17a, connection slice 17c, and the connection layer 18 are formed by the same magnetic material, and set thickness to 3 micrometers. Connection slice 17c is connected to connection slice 10c of the lower magnetic pole layer 10. The up magnetic pole layer 17 consists of magnetic pole partial layer 17a and connection slice 17c, and yoke partial layer 17b mentioned later.

[0067] Magnetic pole partial layer 17a, connection slice 17c, and the connection layer 18 NiFe (nickel:80 % of the weight, Fe:20 % of the weight), NiFe (nickel:45 % of the weight, Fe:55 % of the weight) which is high saturation-magnetic-flux-density material are used. It may form in a predetermined pattern by the galvanizing method, and using material, such as FeN, FeZrN, etc. which are high saturation-magnetic-flux-density material, after a spatter, it **********s alternatively and you may form in a predetermined pattern by ion milling etc. In addition, you may us CoFe, Co system amorphous material, etc. which are high saturation-magnetic-flux-density material.

[0068] Next, as shown in drawing 6 , in the circumference of magnetic pole partial layer 17a, the record gap layer 14 is alternatively **********ed by dry etching by using magnetic pole partial layer 17a as a mask. Reactive ion tching (it is hereafter described as RIE.) which used gas, such as chlorine-based gas of BCl2 and Cl2 grade and fluorine system gas of CF4 and SF6 grade, is used for the dry etching at this time. Next, in the circumference of magnetic pole partial layer 17a, it considers as trim structure as **********s about about 0.3-0.6 micrometers alt rnatively and showed magnetic pole partial layer 10a of the lower magnetic pole layer 10 to drawing 6 (b) by th ion milling using argon system gas by using magnetic pole partial layer 17a as a mask. According to this trim structure, the increase in the effective width of recording track by the breadth of the magnetic flux generated at th tim of the writing of a ** truck can be prevented. In addition, you may make equal the width of face of magnetic pol partial layer 17a and the width of face of magnetic pole partial layer 10a in the pneumatic bearing side 30 over the whole thickness direction. In this case, in the circumference of magnetic pole partial layer 17a, magnetic pole partial layer 17a is used as a mask, and you may ********** the record gap layer 14 and magnetic pole partial layer 10a, and may ********** magnetic pole partial layer 17a, the record gap layer 14, and magnetic pole partial layer 10a by using as a mask the mask layer formed on magnetic pole partial layer 17a.

[0069] Next, the coil insulation layer 19 which consists of an alumina is formed in the whole at the thickness of about 3-4 micrometers. Next, for example by CMP, the coil insulation layer 19 is ground and flattening processing of the front face is carried out until magnetic pole partial layer 17a, connection slice 17c, and the connection layer 18 are exposed.

[0070] Next, as shown in drawing 7 , the 2nd layer portion 20 of the thin film coil which consists of copper is formed by the frame galvanizing method on the coil insulation layer 19 by the thickness of 1.0-2.0 micrometers, and the 1.2-2.0-micrometer coil pitch. The 2nd layer portion 20 of a thin film coil is formed so that it may be wound focusing on connection slice 17c. In addition, sign 20a shows the connection for connecting the 2nd layer portion 20 of a thin film coil to the 1st layer portion 15 among drawing. Connection 20a is connected to connection 15a of the 1st lay r portion 15 through the connection layer 18. Next, a photoresist layer 21 is formed so that the 2nd layer portion 20 of a thin film coil may be covered.

[0071] Next, as shown in drawing 8 , yoke partial layer 17b used as the yoke portion of the up magnetic pole layer 17 is formed at the thickness of 2.0-3.0 micrometers on magnetic pole partial layer 17a, a photoresist layer 21, and connection slice 17c. Using NiFe (nickel:80 % of the weight, Fe:20 % of the weight), NiFe (nickel:45 % of the weight, Fe:55 % of the weight) which is high saturation-magnetic-flux-density material, yoke partial layer 17b may be form d in a predetermined pattern by the galvanizing method, using material, such as FeN, FeZrN, etc. which are high saturation-magnetic-flux-density material, **********s alternatively and may be formed in a predetermined patt rn by ion milling etc. after a spatter. In addition, you may use CoFe, Co system amorphous material, etc. which are high saturation-magnetic-flux-density material. Moreover, it is good also as structure which laid the insulator layer of an inorganic system, and magnetic layers, such as a permalloy, on top of many layers for yoke partial layer 17b because of an improvement of a RF property.

[0072] Moreover, the edge by the side of the pneumatic bearing side 30 of yoke partial layer 17b is arranged in th position distant from the pneumatic bearing side 30.

[0073] Next, the overcoat layer 22 which consists of an alumina is formed in the thickness of 20-40 micrometers, flattening of th front fac is carried out to th whol , and the pad for electrodes which is not illustrat d is form d on it. Finally polish proc ssing of the slider containing abov -mentioned ach class is p rformed, the pneumatic bearing side 30 of the thin film magnetic head containing a recording h ad and th reproducing head is form d, and the thin film magnetic head concerning th g stalt of this operation is completed.

[0074] Drawing 9 is a perspective diagram in which it is shown near th magnetic pole portions of th lower magnetic pole layer 10 in the thin film magn tic h ad conc rning the gestalt of this operation, and th up magnetic pol layer 17.

[0075] With the gestalt of this operation, the lower magnetic pole layer 10 is equivalent to the 1st magnetic layer in this invention, and the up magnetic pole layer 17 is equivalent to the 2nd magnetic layer in this invention. Moreover, the lower shield layer 3 is equivalent to the 1st shield layer in this invention, and the up shield layer 8 is equivalent to the 2nd shield layer in this invention.
[0076] As xplained abov , the thin film magnetic head concerning the gestalt of this operation is equipped with th medium opposed fac (pn umatic bearing side 30) which counters a record medium, the reproducing head, and the recording head (induction type electromagnetism sensing element). The reproducing head and the recording head are magnetically insulated by the insulator layer 9.
[0077] The reproducing head is arranged so that the MR element 5 and the part by the side of the pneumatic bearing side 30 may counter on both sides of the MR element 5, and it has the lower shield layer 3 and the up shield layer 8 which shield the MR element 5.
[0078] The lower magnetic pole layer 10 and the up magnetic pole layer 17 which contain at least one layer including the magnetic pole portion which the recording head of each other is connected magnetically and counters the pneumatic bearing side 30 side mutually, respectively, It has the record gap layer 14 prepared between each magnetic pole portion of these two magnetic pole layers 10 and 17, and the thin film coils 15 and 20 with which the part [at least] was arranged in the state where it insulated to two magnetic pole layers 10 and 17 between these two magnetic pole layers 10 and 17.
[0079] One field (upper surface) adjoins the record gap layer 14, it connects with the field (inferior surface of tongue) of another side of magnetic pole partial layer 10a containing the magnetic pole portion in the lower magnetic pole layer 10, and magnetic pole partial layer 10a, and the lower magnetic pole layer 10 has yoke partial layer 10b us d as the yoke portion in the lower magnetic pole layer 10. The edge by the side of the pneumatic bearing side 30 of yoke partial layer 10b is arranged in the position distant from the pneumatic bearing side 30. The insulating layer 11 is arranged at the portion from the edge by the side of the pneumatic bearing side 30 of yoke partial layer 10b to th pneumatic bearing side 30.
[0080] One field (inferior surface of tongue) adjoins the record gap layer 14, it connects with the field (upper surface) of another side of magnetic pole partial layer 17a containing the magnetic pole portion in the up magnetic pol layer 17, and magnetic pole partial layer 17a, and the up magnetic pole layer 17 has yoke partial layer 17b used as the yoke portion in the up magnetic pole layer 17. The edge by the side of the pneumatic bearing side 30 of yoke partial layer 17b is arranged in the position distant from the pneumatic bearing side 30.
[0081] Moreover, as shown in drawing 9 , magnetic pole partial layer 10a in the lower magnetic pole layer 10 contains the 2nd portion ten a2 into which an end is arranged in the pneumatic bearing side 30, and the 1st portion t n a1 which has width of face at least with a part equal to recording track width of face, and the pneumatic bearing sid 30 in the 1st portion ten a1 are connected with an opposite side, and have larger width of face than recording track width of face. Moreover, the insulating-layer stowage 12 is formed in the field by the side of the record gap layer 14 of magnetic pole partial layer 10a in the pneumatic bearing side 30 from the throat height zero position at the portion of an opposite side. The insulating layer for a throat height convention which is a part of insulating layer 13 (not shown in drawing 9) is contained by this insulating-layer stowage 12. With the gestalt of this operation, the edge by the side of the pneumatic bearing side 30 of the insulating-layer stowage 12 specifies throat height.
[0082] The 2nd portion 17a2 into which the 1st portion 17a1 into which an end is arranged in the pneumatic bearing side 30, and magnetic pole partial layer 17a in the up magnetic pole layer 17 has width of face equal to recording track width of face, and the pneumatic bearing side 30 in the 1st portion 17a1 are connected with an opposite side, and have larger width of face than recording track width of face is included.
[0083] Moreover, the 1st layer portion 15 of a thin film coil is arranged in the side of magnetic pole partial layer 17a of th up magnetic pole layer 17. The 1st layer portion 15 is covered by a photoresist layer 16 and the coil insulation layer 19, and flattening of the upper surface of the coil insulation layer 19 is carried out with the upper surface of magnetic pole partial layer 17a. And the 2nd layer portion 20 of a thin film coil is formed on this coil insulation layer 19.
[0084] As explained above, with the gestalt of this operation, the lower magnetic pole layer 10 and the up magnetic pol layer 17 have the magnetic pole partial layers 10a and 17a and the yoke partial layers 10b and 17b, resp ctively. Therefore, according to the gestalt of this operation, it becomes possible to form minutely the magnetic pole partial layers 10a and 17a containing a magnetic pole portion with a sufficient precision. Moreover, with the gestalt of this operation, the edge by the side of the pneumatic bearing side 30 of each yoke partial layers 10b and 17b is arranged in the position distant from the pneumatic bearing side 30. Therefore, what is necessary is not to be about four layers of the magnetic pole partial layers 10a and 17a and the yoke partial layers 10b and 17b, and to make equal width of face of a magnetic pole portion with the gestalt of this operation, only about two layers of th magnetic pole partial layers 10a and 17a, when making equal the width of face of the magnetic pole portion of the up magnetic pole layer 17 and the width of face of the magnetic pole portion of the lower magn tic pole layer 10 in th pneumatic b aring sid 30. Ther for , according to th gestalt of this operation, it can p rform making qual width of fac of the magnetic pole portion of the up magnetic pol layer 17, and width of face of the magnetic pol portion of th low r magnetic pol layer 10 with an asily and suffici nt precisi n. Acc rding to th g stalt of this operation from the abov thing, it becomes possible to form the magnetic p le portion of a recording head (induction type lectromagn tism sensing element) with a sufficient pr cision.
[0085] Mor over, sinc the edge by th side of th pneumatic bearing sid 30 of each yok partial layers 10b and 17b has been arranged in the position distant from th pneumatic bearing side 30 according to the gestalt of this

operation, the writing of the data to fields other than the field which should be recorded, i.e., a side light, can be prevented.
[0086] By the way, by the compound-die thin film magnetic head of structure by which the lower magnetic pole layer of a recording head served as the up shield layer of the reproducing head, the trouble that a noise occurred or change of a regenerative signal became large was in the regenerative signal in the reproducing head immediately after record operation in a recording head conventionally. It is thought that one of the cause of the is th remnant magnetism generated in a record head end with record operation of a recording head and its change.
[0087] On the other hand, with the gestalt of this operation, while separating the up shield layer 8 of the reproducing head, and the lower magnetic pole layer 10 of a recording head, the insulator layer 9 is arranged among these. Thereby, the influence to the MR element 5 of the remnant magnetism generated in a recording head side can be reduced. Furthermore, with the gestalt of this operation, since the edge by the side of the pneumatic bearing side 30 of yoke partial layer 10b of the lower magnetic pole layer 10 is arranged in the position distant from the pneumatic bearing side 30 and the insulating layer 11 is arranged into the portion from the edge by the side of the pneumatic bearing side 30 of yoke partial layer 10b to the pneumatic bearing side 30, between the magnetic pole portion of a recording head and the MR elements 5 of the reproducing head is magnetically separable with an insulating layer 11. Consequently, according to the gestalt of this operation, the influence to the MR element 5 of the remnant magnetism generated in a recording head side can be further reduced by the insulating layer 11. Therefore, according to the gestalt of this operation, the noise and change which originate in record operation of a recording head and are generated in the regenerative signal in the reproducing head can be reduced.
[0088] Moreover, with the gestalt of this operation, the edge by the side of the pneumatic bearing side 30 of the insulating-layer stowage 12 has prescribed throat height. By the way, there is **** from which the saturation of magnetic flux produces the whole magnetic pole partial layer 10a of the lower magnetic pole layer 10 in this portion in order that the cross section of a magnetic path may decrease rapidly as length equal to throat height by part for the connection of magnetic pole partial layer 10a of the lower magnetic pole layer 10 and yoke partial layer 10b, when the edge of magnetic pole partial layer 10a prescribes throat height. This becomes remarkable when especially throat height becomes small.
[0089] On the other hand, with the gestalt of this operation, the insulating-layer stowage 12 was formed in magnetic pole partial layer 10a of the lower magnetic pole layer 10, and the edge by the side of the pneumatic bearing side 30 of this insulating-layer stowage 12 has prescribed throat height. Therefore, according to the gestalt of this operation, also in the position distant from the pneumatic bearing side 30, magnetic pole partial layer 10a and yok partial layer 10b can be contacted rather than a throat height zero position. Therefore, according to the gestalt of this operation, in the lower magnetic pole layer 10, the cross section of a magnetic path cannot decrease rapidly, and the saturation of the magnetic flux in the middle of being a magnetic path can be prevented. Consequently, according to the gestalt of this operation, it becomes possible to use efficiently for record the magnetomotive forc generated with the thin film coils 15 and 20.
[0090] Moreover, with the gestalt of this operation, the 1st layer portion 15 of a thin film coil is arranged to the side of magnetic pole partial layer 17a of the up magnetic pole layer 17, and is formed on the flat record gap layer 14. Therefore, according to the gestalt of this operation, it becomes possible to form the 1st layer portion 15 with a sufficient precision minutely. Furthermore, with the gestalt of this operation, flattening of the upper surface of the wrap coil insulation layer 19 is carried out for the 1st layer portion 15 with the upper surface of magnetic pole partial layer 17a, and the 2nd layer portion 20 of a thin film coil is formed on this flat coil insulation layer 19. Th refore, according to the gestalt of this operation, it becomes possible to also form the 2nd layer portion 20 with a sufficient precision minutely. Moreover, according to the gestalt of this operation, the edge of the 1st layer portion 15 of a thin film coil can be arranged near the edge of an opposite side in the pneumatic bearing side 30 of magnetic pol partial layer 17a.
[0091] According to the gestalt of this operation from these things, compared with the former, it becomes reducibl [magnetic-path length]. Furthermore, it can prevent that the magnetomotive force generated with the thin film coils 15 and 20 is saturated on the way, and the magnetomotive force generated with the thin film coils 15 and 20 can be efficiently used for record. Therefore, according to the gestalt of this operation, it becomes possible to offer the thin film magnetic head which was excellent in the over-writing property which are the RF property of a recording head, a nonlinear transition shift (Non-linear Transition Shift;NLTS), and a property in the case of carrying out overwrite.
[0092] With reference to [the gestalt of the 2nd operation] next drawing 10 , or drawing 14 , the thin film magnetic head concerning the gestalt of operation of the 2nd of this invention and its manufacture method are explained. In addition, in drawing 10 or drawing 14 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.
[0093] The thin film magnetic head concerning the gestalt of this operation is the example which constitutes a thin film coil from one layer, and specified throat height by the up magnetic pole layer side. The proc ss which forms the up shield gap film 7 by the manufacture m thod of th thin film magn tic head conc rning th gestalt of this operation is the sam as th gestalt of the 1st operation.
[0094] In the gestalt of this operation next, as shown in drawing 10 , th up shield lay r 8 for the reproducing heads which consists of a magnetic material, for example, a permalloy, is alternatively formed by the thickness of 1.0 micromet rs on th up shield gap film 7. Next, it grinds until it forms in th thickn ss of about 2-3 microm ters th insulating lay r 34 which consists of an alumina, for example, the up shield layer 8 is expos d to the whole with

CMP, and flattening processing of the front face is carried out.
[0095] Next, the insulator layer 9 which consists of an alumina in order to insulate the reproducing head and a recording head magnetically is formed on the up shield layer 8 and an insulating layer 34 at the thickness of 0.1-0.2 micrometers.
[0096] N xt, yoke partial layer 40b which becomes a yok portion in the lower magnetic pol layer 40 for recording heads by the magnetic material is alternatively formed by the thickness of 1.5 micrometers on an insulator layer 9. In addition, the lower magnetic pole layer 40 consists of this yoke partial layer 40b, and magnetic pole partial layer 40a and connection slice 40c which are mentioned later. The edge by the side of the pneumatic bearing side 30 of yoke partial layer 40b is arranged in the position distant from the pneumatic bearing side 30. The material and the formation method of yoke partial layer 40b are the same as that of yoke partial layer 10b in the gestalt of the 1st operation.
[0097] Next, it grinds until it forms in the thickness of about 2-3 micrometers the insulating layer which consists of an alumina, for example, yoke partial layer 40b is exposed to the whole with CMP, and flattening processing of the front face is carried out. Thereby, as shown in drawing 10 , in the portion from the edge by the side of the pneumatic bearing side 30 of yoke partial layer 40b to the pneumatic bearing side 30, an insulating layer 41 is formed on an insulator layer 9.
[0098] Next, while forming magnetic pole partial layer 40a of the lower magnetic pole layer 40 on an insulating layer 41 and yoke partial layer 40b, connection slice 40c is formed on yoke partial layer 40b. Magnetic pole partial layer 40a contains the magnetic pole portion in the lower magnetic pole layer 40. Connection slice 40c is arranged in the position near the center of the thin film coil mentioned later. Thickness of magnetic pole partial layer 40a and connection slice 40c is set to 1.0 micrometers.
[0099] The material and the formation method of magnetic pole partial layer 40a of the lower magnetic pole layer 40 and connection slice 40c are the same as that of magnetic pole partial layer 10a of the lower magnetic pole layer 10 and connection slice 10c in the gestalt of the 1st operation.
[0100] Next, it grinds until it forms in the thickness of about 2-3 micrometers the insulating layer 43 which consists of an alumina, for example, magnetic pole partial layer 40a and connection slice 40c are exposed to the whole with CMP, and flattening processing of the front face is carried out.
[0101] Next, the record gap layer 44 which becomes the whole from an insulating material is formed in the thickness of 0.1-0.15 micrometers. The material and the formation method of the record gap layer 44 are the same as that of th record gap layer 14 in the gestalt of the 1st operation.
[0102] Next, for magnetic-path formation, in the position near the center of the thin film coil mentioned later, the record gap layer 44 is **********ed partially and contact hole 44A is formed.
[0103] Next, as shown in drawing 11 , the thin film coil 45 which consists of copper is formed by the frame galvanizing method on the record gap layer 44 by the thickness of 1.0-2.0 micrometers, and the 1.2-2.0-micrometer coil pitch. The thin film coil 45 is formed so that it may be wound focusing on connection slice 40c. In addition, sign 45a shows among drawing the connection for connecting with the lead layer 50 which mentions the thin film coil 45 later. Next, a photoresist layer 46 is formed so that the thin film coil 45 may be enclosed.
[0104] Next, as shown in drawing 12 , in the position near [by the side of the pneumatic bearing side 30 of the record gap layer 44] the edge, magnetic pole partial layer 47a containing the magnetic pole portion in the up magnetic pole layer 47 is formed on the record gap layer 44. At this time, simultaneously, connection slice 47c is formed on contact hole 44A, and the connection layer 48 is formed on connection 45a in the thin film coil 45. Magnetic pole partial layer 47a, connection slice 47c, and the connection layer 48 are formed by the same magnetic material, and set thickness to 3 micrometers.
[0105] Connection slice 47c is connected to connection slice 40c of the lower magnetic pole layer 40. The up magnetic pole layer 47 consists of magnetic pole partial layer 47a and connection slice 47c, and yoke partial layer 47b mentioned later.
[0106] The material and the formation method of magnetic pole partial layer 47a, connection slice 47c, and the connection layer 48 are the same as that of magnetic pole partial layer 17a in the gestalt of the 1st operation, conn ction slice 17c, and the connection layer 18.
[0107] With the gestalt of this operation, it is formed on a photoresist layer 46 near [a part of] the edge of an opposite side in the pneumatic bearing side 30 in magnetic pole partial layer 47a. Moreover, the edge by the side of the pneumatic bearing side 30 of a photoresist layer 46 specifies throat height. Therefore, with the gestalt of this operation, a part of photoresist layer 46 arranged between magnetic pole partial layer 47a and the record gap layer 44 turns into an insulating layer for a throat height convention. Moreover, the portion which contains the insulating layer for a throat height convention in magnetic pole partial layer 47a serves as an insulating-layer stowage.
[0108] Next, in the circumference of magnetic pole partial layer 47a, the record gap layer 44 is alternatively **********ed by dry etching by using magnetic pole partial layer 47a as a mask. Next, in the circumference f magn tic pole partial lay r 47a, it consid rs as trim structure as **********s about about 0.3-0.6 microm t rs alt rnativ ly and show d magnetic pole partial lay r 40a of the lower magnetic pol lay r 40 to drawing 12 (b) by the ion milling using argon system gas by using magn tic pol partial layer 47a as a mask. In addition, you may mak equal th width of fac of magnetic pole partial layer 47a and the width of face of magn tic pol partial layer 40a in th pneumatic b aring sid 30 over th whole thickn ss dir ction. In this cas , in th circumf rence of magn tic pol partial lay r 47a, magnetic pole partial layer 47a is used as a mask, and you may ********** the record gap lay r 44 and magnetic pole partial layer 40a, and may ********** magnetic pole partial layer 47a, the record gap

layer 44, and magnetic pole partial layer 40a by using as a mask the mask layer formed on magnetic pole partial layer 47a.

[0109] Next, as shown in drawing 13 , the coil insulation layer 49 which consists of an alumina is formed in the whole at the thickness of about 3-4 micrometers. Next, for example by CMP, the coil insulation layer 49 is ground and flattening processing of the front face is carried out until magnetic pole partial layer 47a, connection slic 47c, and the connection lay r 48 are exposed.

[0110] Next, yoke partial layer 47b used as the yoke portion of the up magnetic pole layer 47 is formed at the thickness of 2.0-3.0 micrometers on magnetic pole partial layer 47a, the coil insulation layer 49, and connection slice 47c. At this time, the lead layer 50 connected to the connection layer 48 is simultaneously formed on the coil insulation layer 49 at the thickness of 2.0-3.0 micrometers. The material and the formation method of yoke partial layer 47b and the lead layer 50 are the same as that of yoke partial layer 17b in the gestalt of the 1st operation. Moreover, the edge by the side of the pneumatic bearing side 30 of yoke partial layer 47b is arranged in the position distant from the pneumatic bearing side 30.

[0111] Next, as shown in drawing 14 , the overcoat layer 52 which consists of an alumina is formed in the thickness of 20-40 micrometers, flattening of the front face is carried out to the whole, and the pad for electrodes which is not illustrated is formed on it. Finally polish processing of the slider containing above-mentioned each class is performed, the pneumatic bearing side 30 of the thin film magnetic head containing a recording head and the reproducing head is formed, and the thin film magnetic head concerning the gestalt of this operation is completed.

[0112] With the gestalt of this operation, the lower magnetic pole layer 40 is equivalent to the 1st magnetic layer in this invention, and the up magnetic pole layer 47 is equivalent to the 2nd magnetic layer in this invention.

[0113] With the gestalt of this operation, while arranging the thin film coil 45 to the side of magnetic pole partial layer 47a of the up magnetic pole layer 47, flattening of the upper surface of the wrap coil insulation layer 49 is carried out for the thin film coil 45 with the upper surface of magnetic pole partial layer 47a, and yoke partial layer 47b of the up magnetic pole layer 47 is formed on this flat coil insulation layer 49. Therefore, according to the gestalt of this operation, it becomes possible to form yoke partial layer 47b with a sufficient precision.

[0114] The composition of others in the gestalt of this operation, the operation, and the effect are the same as th g stalt of the 1st operation.

[0115] With reference to [the gestalt of the 3rd operation] next drawing 15 , or drawing 18 , the thin film magnetic head concerning the gestalt of operation of the 3rd of this invention and its manufacture method are explained. In addition, in drawing 15 or drawing 18 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.

[0116] The thin film magnetic head concerning the gestalt of this operation is the example which constitutes a thin film coil from one layer, and specified throat height by the up magnetic pole layer side like the gestalt of the 2nd operation. The process which forms the record gap layer 44 and forms contact hole 44A in this record gap layer 44 by the manufacture method of the thin film magnetic head concerning the gestalt of this operation is the same as the gestalt of the 2nd operation.

[0117] With the gestalt of this operation next, as shown in drawing 15 , the insulating layer 66 which is missing from the position near the contact hole 44A from the position which only a predetermined distance separated from the pn umatic bearing side 30 on the record gap layer 44, for example, consists of an alumina is formed in the thickness of 0.8 micrometers.

[0118] Next, sputtering of the high saturation-magnetic-flux-density material, such as FeN and FeCo, is carried out to the whole, and patterning-ed film 67p is formed in it at the thickness of 1.5-2.0 micrometers. Next, the mask lay rs 68a and 68b of a predetermined pattern are formed by insulating materials, such as an alumina, on this patterning-ed film 67p at the thickness of 1.0 micrometers. Mask layer 68a is formed on the portion used as magnetic pole partial layer 67a later mentioned among patterning-ed film 67p, and mask layer 68b is formed on the portion located on contact hole 44A among patterning-ed film 67p. On for example, an alumina layer, the mask lay rs 68a and 68b form the metal layer by which patterning was carried out, and are formed by **********ing an alumina layer by RIE by using this metal layer as a mask.

[0119] Next, patterning-ed film 67p and an insulating layer 66 are **********ed by RIE by using the mask layers 68a and 68b as a mask. By this, patterning of the patterning-ed film 67p is carried out, magnetic pole partial layer 67a containing the magnetic pole portion of the up magnetic pole layer 67 and connection slice 67c connected to th lower magnetic pole layer 40 are formed, patterning of the insulating layer 66 is carried out, and it is set to insulating-layer 66a for a throat height convention. Moreover, the portion which contains insulating-layer 66a for a throat height convention in magnetic pole partial layer 67a serves as an insulating-layer stowage. The up magnetic pol layer 67 consists of magnetic pole partial layer 67a and connection slice 67c, and yoke partial layer 67b m ntioned later.

[0120] Next, in the circumference of magnetic pole partial layer 67a, trim structure as **********s and showed magnetic pol partial layer 40a of th r cord gap layer 44 and the lower magnetic pol lay r 40 to drawing 15 (b) is formed by RIE by using mask lay r 68a as a mask.

[0121] N xt, as shown in drawing 16 , the thin film coil 69 which consists of copper is form d by the frame galvanizing method on th r cord gap layer 44 by the thickness of 1.0-2.0 micrometers, and the 1.2-2.0-micromet r coil pitch. Th thin film coil 69 is formed so that it may b wound focusing on connection slic 68c. In addition, sign 69a shows among drawing the conn ction for connecting with th lead lay r 72 which mentions the thin film coil 69 later. N xt, a photor sist lay r 70 is form d so that the thin film coil 69 may b enclos d.

[0122] Next, as shown in drawing 17 , the coil insulation layer 71 which consists of an alumina is formed in the whole at th thickness of about 3-4 micrometers. Next, for example by CMP, the coil insulation layer 71 is ground and flattening processing of the front face is carried out until magnetic pole partial layer 67a and connection slice 67c are exposed. Next, in the portion on connection 69a of the thin film coil 69, the coil insulation layer 71 is **********ed partially, and a contact hole is formed.

[0123] Next, yoke partial layer 67b used as the yoke portion of the up magnetic pole layer 67 is formed at the thickness of 2.0-3.0 micrometers on magnetic pole partial layer 67a, the coil insulation layer 71, and connection slice 67c. At this time, the lead layer 72 connected to thin film coil 69 connection 69a is simultaneously formed on the coil insulation layer 71 at the thickness of 2.0-3.0 micrometers. The material and the formation method of yoke partial layer 67b and the lead layer 72 are the same as that of yoke partial layer 17b in the gestalt of the 1st operation. Moreover, the edge by the side of the pneumatic bearing side 30 of yoke partial layer 67b is arranged in th position distant from the pneumatic bearing side 30.

[0124] Next, as shown in drawing 18 , the overcoat layer 73 which consists of an alumina is formed in the thickness of 20-40 micrometers, flattening of the front face is carried out to the whole, and the pad for electrodes which is not illustrated is formed on it. Finally polish processing of the slider containing above-mentioned each class is p rformed, the pneumatic bearing side 30 of the thin film magnetic head containing a recording head and the reproducing head is formed, and the thin film magnetic head concerning the gestalt of this operation is completed.

[0125] With the gestalt of this operation, the up magnetic pole layer 67 is equivalent to the 2nd magnetic layer in this invention.

[0126] In addition, you may make it ********** by the focused ion beam in the gestalt of this operation instead of **********ing magnetic pole partial layer 40a of magnetic pole partial layer 67a of the up magnetic pole layer 67, the record gap layer 44, and the lower magnetic pole layer 40 by RIE.

[0127] The composition of others in the gestalt of this operation, the operation, and the effect are the same as the gestalt of the 2nd operation.

[0128] With reference to [the gestalt of the 4th operation] next drawing 19 , or drawing 25 , the thin film magnetic h ad concerning the gestalt of operation of the 4th of this invention and its manufacture method are explained. In addition, in drawing 19 or drawing 25 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.

[0129] The process which forms an insulator layer 9 by the manufacture method of the thin film magnetic head concerning the gestalt of this operation is the same as the gestalt of the 1st operation.

[0130] In the gestalt of this operation next, as shown in drawing 19 , yoke partial layer 80b which becomes a yoke portion in the lower magnetic pole layer 80 for recording heads by the magnetic material is alternatively formed by th thickness of 1.0-1.5 micrometers on an insulator layer 9. In addition, the lower magnetic pole layer 80 consists of this yoke partial layer 80b, and magnetic pole partial layer 80a and connection slice 80c which are mentioned later. The edge by the side of the pneumatic bearing side 30 of yoke partial layer 80b is arranged in the position distant from the pneumatic bearing side 30. The material and the formation method of yoke partial layer 80b are the same as that of yoke partial layer 80b in the gestalt of the 1st operation.

[0131] Next, it grinds until it forms in the thickness of about 2-3 micrometers the insulating layer which consists of an alumina, for example, yoke partial layer 80b is exposed to the whole with CMP, and flattening processing of the front face is carried out. Thereby, as shown in drawing 19 , in the portion from the edge by the side of the pneumatic bearing side 30 of yoke partial layer 80b to the pneumatic bearing side 30, an insulating layer 81 is formed on an insulator layer 9. Moreover, an insulating layer 32 is formed in other portions on an insulator layer 9.

[0132] Next, as shown in drawing 20 , while forming magnetic pole partial layer 80a of the lower magnetic pole layer 80 on an insulating layer 81 and yoke partial layer 80b, connection slice 80c is formed on yoke partial layer 80b. Magnetic pole partial layer 80a contains the magnetic pole portion in the lower magnetic pole layer 80. Connection slic 80c is arranged in the position near the center of the thin film coil mentioned later. Thickness of magnetic pole partial layer 80a and connection slice 80c is set to 1.0-1.5 micrometers. The material and the formation method of magnetic pole partial layer 80a and connection slice 80c are the same as that of magnetic pole partial layer 10a and connection slice 10c in the gestalt of the 1st operation.

[0133] Next, only 0.3-0.6 micrometers **********s the portion of an opposite side by ion milling etc. in the pneumatic bearing side 30 from a desired throat height zero position among the upper surfaces of magnetic pole partial layer 80a. The insulating-layer stowage 82 which contains by this the insulating layer for a throat height convention for specifying the throat height later mentioned into the portion of an opposite side in a throat height zero position to the pneumatic bearing side 30 in magnetic pole partial layer 80a is formed.

[0134] Next, as shown in drawing 21 , the insulator layer 83 which consists of an alumina is formed in the whole at th thickness of about 0.3-0.5 micrometers.

[0135] Next, the 1st layer portion 84 of the thin film coil which consists of copper is formed by the frame galvanizing method on an insulator layer 83 at th thickness of 0.8-1.0 microm ters. The 1st lay r portion 84 of a thin film coil is formed so that it may b wound focusing on conn ction slic 80c. In addition, sign 84a shows among drawing th conn ction for connecting with th 2nd lay r portion 88 which mentions th 1st layer portion 84 of a thin film coil lat r. N xt, a photoresist lay r 85 is formed so that th 1st lay r portion 84 of a thin film coil may be enclosed.

[0136] Next, as shown in drawing 22 , th coil insulation layer 86 which consists of an alumina is formed in the whole by the thickn ss of about 3-4 micrometers. Next, for example by CMP, th coil insulation layer 86 is ground and flatt ning processing of th front face is carried out until magnetic pol partial lay r 80a of th lower magn tic pol

layer 80 and connection slice 80c are exposed. Although drawing 22 has not exposed the 1st layer portion 84 of a thin film coil, you may make it the 1st layer portion 84 expose it here. The portion contained by the insulating-layer stowage 82 among the coil insulation layers 86 serves as an insulating layer for a throat height convention.
[0137] Next, the record gap layer 87 which becomes th whole from an insulating material is formed in the thickness of 0.1-0.15 micrometers. The material and the formation method of the record gap layer 87 are the same as that of th record gap layer 14 in the gestalt of the 1st operation.
[0138] Next, in the position on connection slice 80c and connection 84a, the record gap layer 87 is **********ed partially and a contact hole is formed.
[0139] Next, as shown in drawing 23 , the 2nd layer portion 88 of the thin film coil which consists of copper is formed by the frame galvanizing method on the record gap layer 87 at the thickness of 0.8-1.0 micrometers. The 2nd layer portion 88 of a thin film coil is formed so that it may be wound focusing on connection slice 80c. In addition, sign 88a shows the connection for connecting the 2nd layer portion 88 of a thin film coil to the 1st layer portion 84 among drawing. Next, a photoresist layer 89 is formed so that the 2nd layer portion 88 of a thin film coil may be enclosed.
[0140] Next, in the position near [by the side of the pneumatic bearing side 30 of the record gap layer 87] the edge, magnetic pole partial layer 90a containing the magnetic pole portion in the up magnetic pole layer 90 is form d on the record gap layer 87. At this time, connection slice 90c is simultaneously formed on connection slice 80c of th lower magnetic pole layer 80. Magnetic pole partial layer 90a and connection slice 90c are formed by the same magnetic material, and thickness is set to 2-3 micrometers. The up magnetic pole layer 90 consists of magnetic pole partial layer 90a and connection slice 90c, and yoke partial layer 90b mentioned later.
[0141] The material and the formation method of magnetic pole partial layer 90a and connection slice 90c are the same as that of magnetic pole partial layer 17a and connection slice 17c in the gestalt of the 1st operation.
[0142] Next, in the circumference of magnetic pole partial layer 90a, the record gap layer 87 is alternatively **********ed by dry etching by using magnetic pole partial layer 90a as a mask. Next, in the circumference of magnetic pole partial layer 90a, it considers as trim structure as **********s about about 0.3-0.6 micrometers alternatively and showed magnetic pole partial layer 80a of the lower magnetic pole layer 80 to drawing 23 (b) by th ion milling using argon system gas by using magnetic pole partial layer 90a as a mask. In addition, you may make equal the width of face of magnetic pole partial layer 90a and the width of face of magnetic pole partial layer 80a in th pneumatic bearing side 30 over the whole thickness direction. In this case, in the circumference of magnetic pole partial layer 90a, magnetic pole partial layer 90a is used as a mask, and you may ********** the record gap layer 87 and magnetic pole partial layer 80a, and may ********** magnetic pole partial layer 90a, the record gap layer 87, and magnetic pole partial layer 80a by using as a mask the mask layer formed on magnetic pole partial lay r 90a.
[0143] Next, as shown in drawing 24 , the coil insulation layer 91 which consists of an alumina is formed in the whol at the thickness of about 3-4 micrometers. Next, for example by CMP, the coil insulation layer 91 is ground and flattening processing of the front face is carried out until magnetic pole partial layer 90a and connection slice 90c ar xposed.
[0144] Next, as shown in drawing 25 , yoke partial layer 90b used as the yoke portion of the up magnetic pole layer 90 is formed at the thickness of 2.0-3.0 micrometers on magnetic pole partial layer 90a, the coil insulation layer 91, and connection slice 90c. The edge by the side of the pneumatic bearing side 30 of yoke partial layer 90b is arranged in the position distant from the pneumatic bearing side 30. The material and the formation method of yoke partial layer 90b are the same as that of yoke partial layer 17b in the gestalt of the 1st operation.
[0145] Next, the overcoat layer 92 which consists of an alumina is formed in the thickness of 20-40 micrometers, flattening of the front face is carried out to the whole, and the pad for electrodes which is not illustrated is formed on it. Finally polish processing of the slider containing above-mentioned each class is performed, the pneumatic b aring side 30 of the thin film magnetic head containing a recording head and the reproducing head is formed, and th thin film magnetic head concerning the gestalt of this operation is completed.
[0146] With the gestalt of this operation, the lower magnetic pole layer 80 is equivalent to the 1st magnetic layer in this invention, and the up magnetic pole layer 90 is equivalent to the 2nd magnetic layer in this invention.
[0147] With the gestalt of this operation, the 1st layer portion 84 of a thin film coil is arranged to the side of magnetic pole partial layer 80a of the lower magnetic pole layer 80, and is formed on the flat insulator layer 83. Therefore, according to the gestalt of this operation, it becomes possible to form the 1st layer portion 84 with a sufficient precision minutely. Moreover, according to the gestalt of this operation, the edge of the 1st layer portion 84 of a thin film coil can be arranged near the edge of an opposite side in the pneumatic bearing side 30 of magnetic pole partial layer 80a.
[0148] With the gestalt of this operation, the 1st layer portion 84 of a thin film coil is arranged to the side of magnetic pole partial layer 80a of the lower magnetic pole layer 80. Flattening of the upper surface of the wrap coil insulation lay r 86 is carried out for th 1st layer portion 84 of a thin film coil with th upper surfac of magnetic pole partial layer 80a of th lower magnetic pole layer 80, and the 2nd layer portion 88 of a thin film coil is formed through th r cord gap layer 87 on this field by which flatt ning was carri d out. Th r fore, according to the g stalt of this op ration, it becomes possibl to also form th 2nd layer portion 88 with a suffici nt pr cision minutely. Mor over, according to the gestalt of this operation, the dg of th 2nd lay r portion 88 of a thin film coil can b arrang d near the edge of an opposit side in th pn umatic bearing side 30 of magnetic pol partial layer 90a of th up magnetic pole layer 90.

[0149] According to the gestalt of this operation, it becomes reducible [the magnetic-path length in a recording head] from the above thing.
[0150] Moreover, since each of magnetic pole partial layer 90a of the up magnetic pol layer 90 and yoke partial layer 90b is formed on the field by which flattening was carried out according to the gestalt of this operation, it becomes possible to form minutely magnetic pole partial layer 90a and yoke partial layer 90b with a sufficient precision.
[0151] The composition of others in the gestalt of this operation, the operation, and the effect are the same as th gestalt of the 1st operation.
[0152] this invention is not limited to the gestalt of each above-mentioned implementation, but various change is possible for it. the gestalt of each above-mentioned implementation for example, — a base side — reading — MR element of business — forming — the induction type for writing to a it top — electromagnetism — although the thin film magnetic head of the structure which carried out the laminating of the sensing element was explained, you may make this built-up sequence reverse
[0153] that is, a base side — writing in — the induction type of business — electromagnetism — a sensing element may be formed and MR element for reading may be formed on it Such structure is realizable by forming in a base side by using as a lower magnetic pole layer the magnetic film which has the function of the up magnetic pole layer shown in the gestalt of the above-mentioned implementation for example, and forming the magnetic film which has the function of the lower magnetic pole layer it was indicated to the gestalt of the above-mentioned implementation that countered it as an up magnetic pole layer through a record gap film.
[0154] moreover, this invention — an induction type — electromagnetism — the thin film magnetic head equipped only with the sensing element only for records, and an induction type — electromagnetism — it is applicable also to the thin film magnetic head which performs record and reproduction by the sensing element
[0155]
[Effect of the Invention] As explained above, according to the manufacture method of the thin film magnetic head according to claim 1 to 8 or the thin film magnetic head according to claim 9 to 16 Since it is arranged in the position where the 1st magnetic layer and 2nd magnetic layer have [both] a magnetic pole partial layer and a yok partial layer, and the edge by the side of the medium opposed face of each yoke partial layer separated from the medium opposed face forming two magnetic pole partial layers with a sufficient precision — possible — thereby — an induction type — electromagnetism — the effect of becoming possible to form the magnetic pole portion of a sensing element with a sufficient precision is done so Moreover, since the edge by the side of the medium opposed face of each yoke partial layer is arranged in the position distant from the medium opposed face according to this invention, the effect that the writing of the data to fields other than the field which should be recorded can be prevented is done so.
[0156] Moreover, according to the manufacture method of the thin film magnetic head according to claim 5 or 6 or the thin film magnetic head according to claim 13 or 14, since some thin film coils [at least] have been arranged to the side of the 1st magnetic pole partial layer, some [at least] edges of a thin film coil can be arranged near the edge of the 1st magnetic pole partial layer, consequently the effect that reduction of magnetic-path length is attained is done so.
[0157] Moreover, according to the manufacture method of the thin film magnetic head according to claim 6 or the thin film magnetic head according to claim 14 Since the coil insulation layer to which some thin film coils [at least] arranged in the side of the 1st magnetic pole partial layer were covered, and flattening of the field by the side of a gap layer was carried out with the field by the side of the gap layer in the 1st magnetic pole partial layer was prepared The effect of becoming possible to form the layer which adjoins a coil insulation layer with a sufficient precision is done so.
[0158] Moreover, according to the manufacture method of the thin film magnetic head according to claim 7 or 8 or th thin film magnetic head according to claim 15 or 16, since some thin film coils [at least] have been arranged to th side of the 2nd magnetic pole partial layer, some [at least] edges of a thin film coil can be arranged near the dge of the 2nd magnetic pole partial layer, consequently the effect that reduction of magnetic-path length is attained is done so.
[0159] Moreover, according to the manufacture method of the thin film magnetic head according to claim 8 or the thin film magnetic head according to claim 16 Since the coil insulation layer to which some thin film coils [at least] arranged in the side of the 2nd magnetic pole partial layer were covered, and flattening of the field by the side of the 2nd yoke partial layer was carried out with the field by the side of the 2nd yoke partial layer in the 2nd magnetic pole partial layer was prepared The effect of becoming possible to form the layer which adjoins a coil insulation layer with a sufficient precision is done so.
[0160] Moreover, according to the manufacture method of the thin film magnetic head according to claim 17 to 22 or th thin film magnetic head according to claim 23 to 28 Since it is arranged in the position where the 1st magnetic layer has a magnetic pole partial layer and a yoke partial lay r, and th edg by th sid of th medium opposed fac of a yoke partial layer separat d from the medium oppos d fac The ff ct of it being possible to form th magn tic pole partial lay r of the 1st magnetic lay r with a suffici nt pr cision, and b coming possibl t form a magnetic pole portion with a sufficient precision by this is done so. Moreover, since the dge by th side of the medium opposed fac of a yoke partial lay r is arranged in the position distant from the medium opposed fac according to this inv ntion, the effect that th writing of th data to fi lds other than the field which should b recorded can be prevented is done so. Moreover, according to this invention, by arranging th edg by th side of

the medium opposed face of a yoke partial layer in the position distant from the medium opposed face, between the magnetic pole portion of a recording head and the magnetic resistance elements of the reproducing head can be separated magnetically, and the effect that the noise and change which originat in record operation of a recording head and are generated in the regenerative signal in the reproducing head can be reduced is don so.

[0161] Moreover, according to the manufacture method of the thin film magnetic head according to claim 21 or 22 or the thin film magnetic head according to claim 27 or 28, since some thin film coils [at least] have been arranged to the side of a magnetic pole partial layer, some [at least] edges of a thin film coil can be arranged near the edge of a magnetic pole partial layer, consequently the effect that reduction of magnetic-path length is attained is done so.

[0162] Moreover, according to the manufacture method of the thin film magnetic head according to claim 22 or the thin film magnetic head according to claim 28 Since the coil insulation layer to which some thin film coils [at least] arranged in the side of a magnetic pole partial layer were covered, and flattening of the field by the side of a gap layer was carried out with the field by the side of the gap layer in the 1st magnetic pole partial layer was prepared Th effect of becoming possible to form the layer which adjoins a coil insulation layer with a sufficient precision is done so.

[Translation done.]